

Linked Disturbance Interactions in South-Central Alaska: Implications for Ecosystems and People



Winslow D. Hansen
Master's Defense

General Introduction

Ecosystem Stewardship: Sustain long-term provision of **ecosystem services** that support human **wellbeing** under conditions of **uncertainty** and **change**.

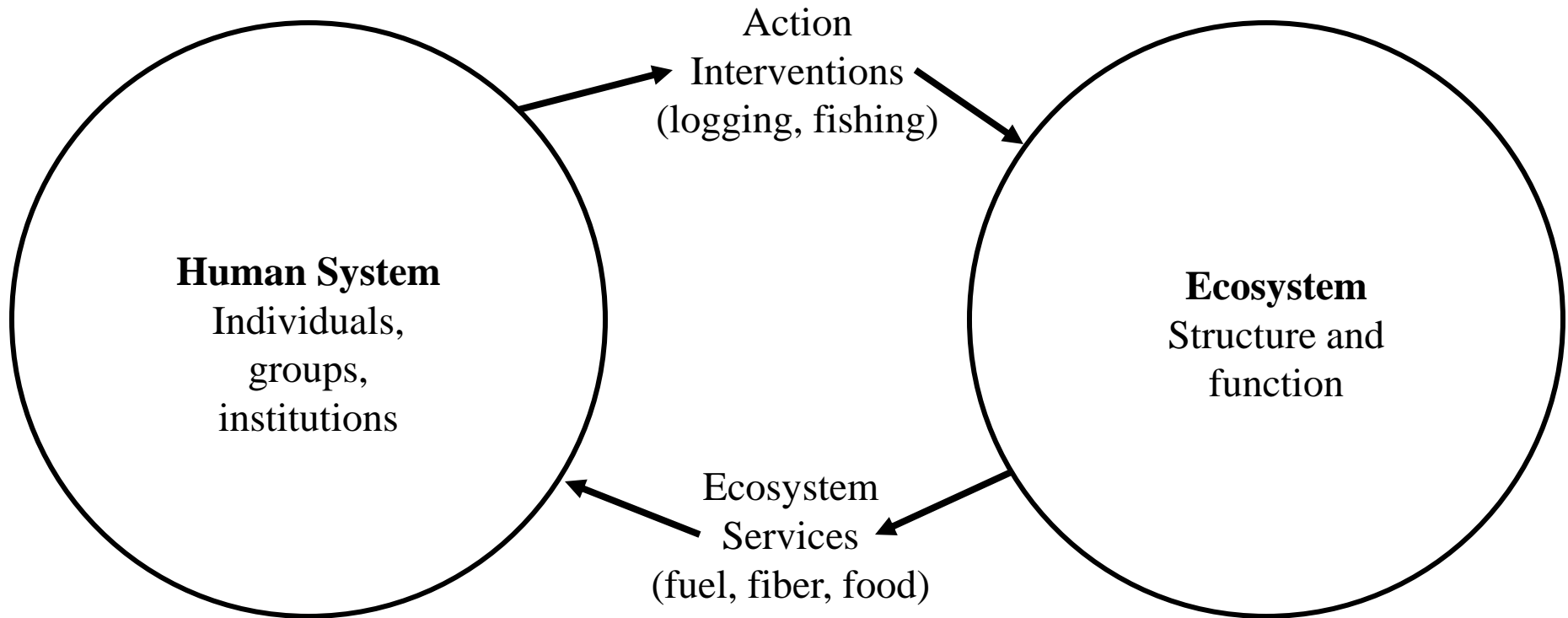


Boreal Forest of Alaska

- Temperature warmed 2°C between 1960-2000.
- Boreal forest covers 46 million hectares of Alaska.
 - Natural disturbances historically critical.
 - Trends are associated with ecological change and uncertainty.



Social-Ecological System (SES)

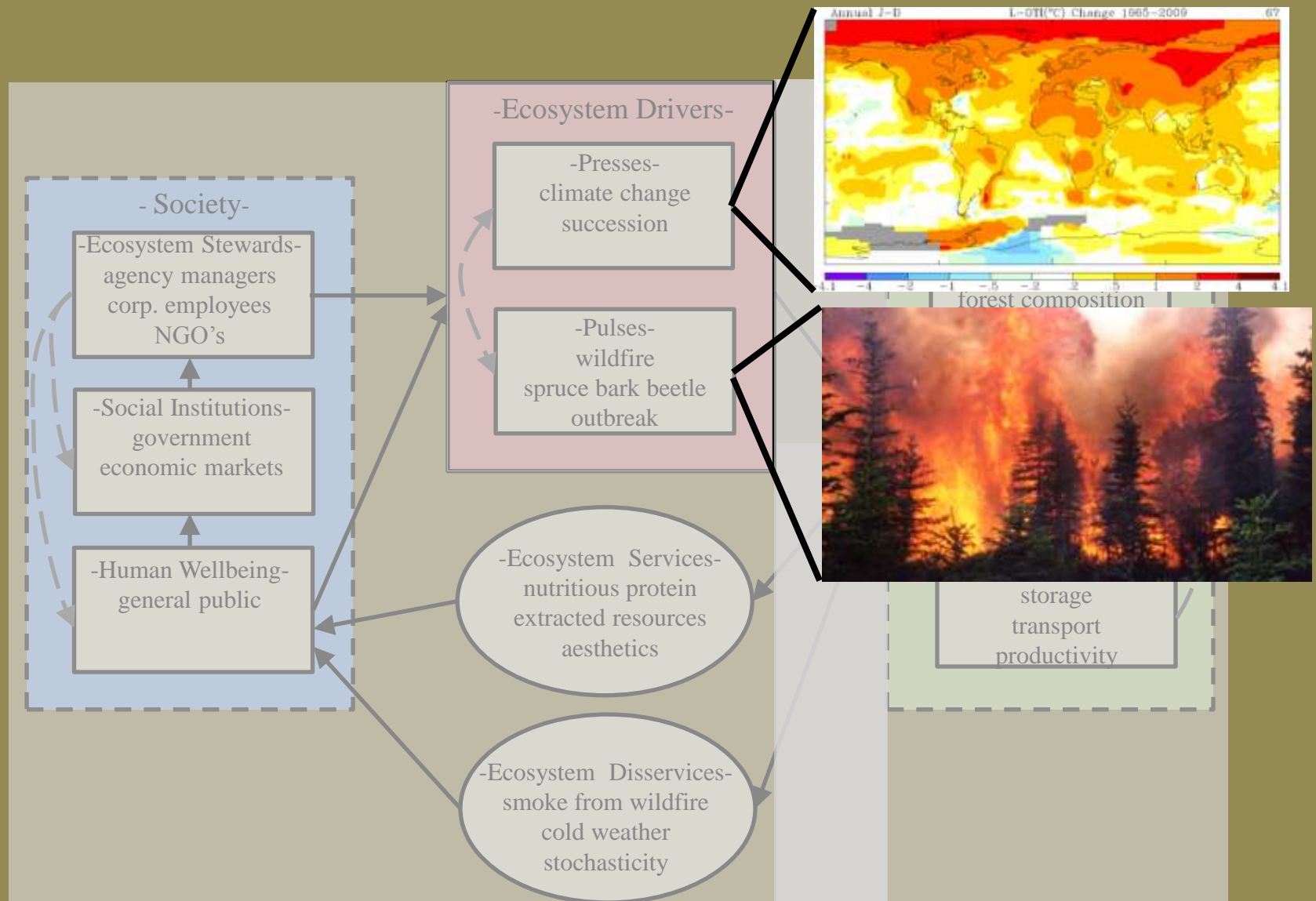


Social-Ecological System

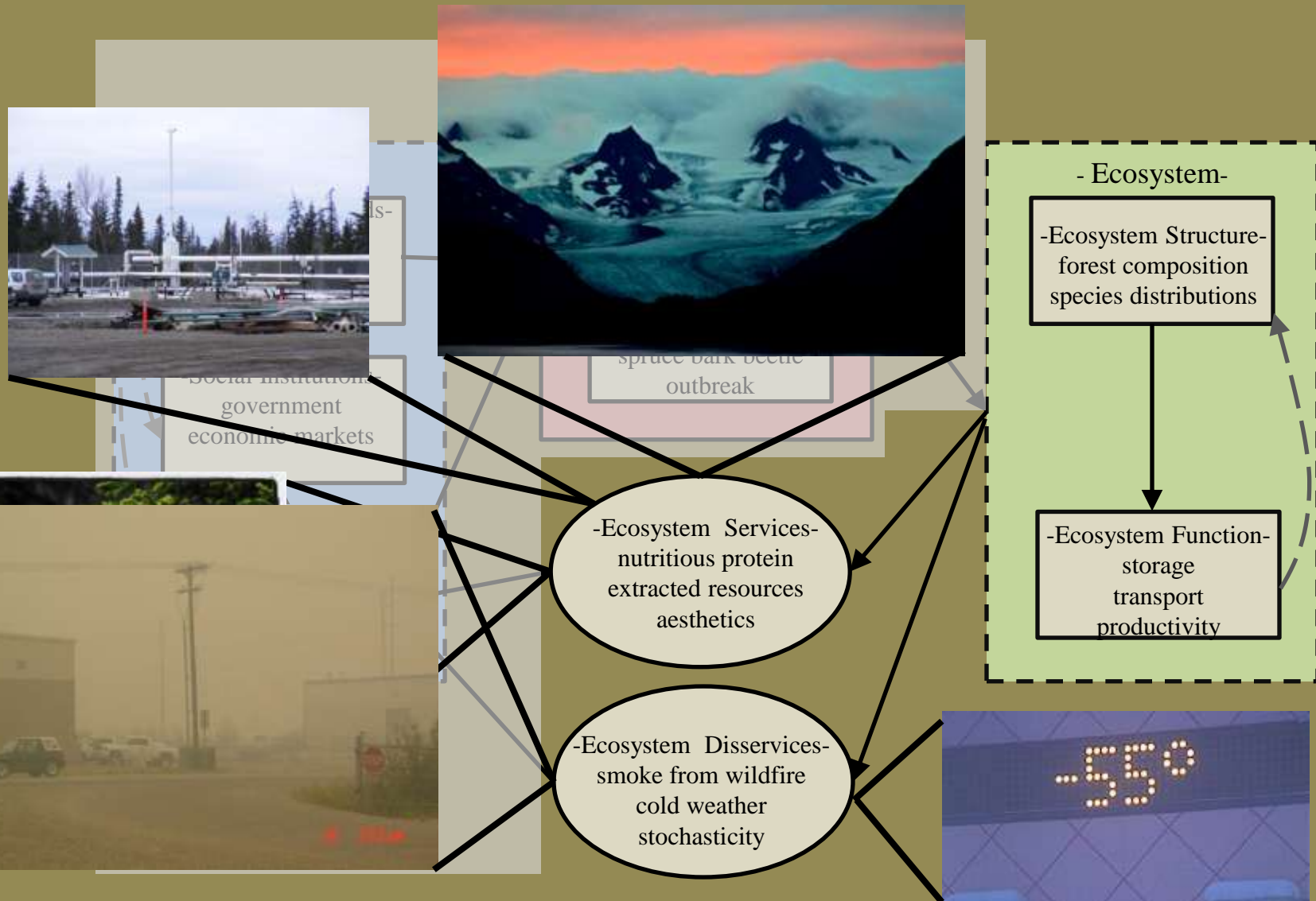
Thesis Objectives

- **Objective 1:** Introduce an **adapted SES framework** for the Alaskan boreal forest.
- **Objective 2:** Examine interactions between **natural disturbances** and the ecological **consequences** of those interactions in a **boreal SES**.
- **Objective 3:** Evaluate how **natural disturbances** affect human wellbeing, proxied by property values, in a **boreal SES**.
- **Objective 4:** Develop axioms for implementing **ecosystem stewardship based management** approaches in a **boreal SES**.

The Press-Pulse SES Framework

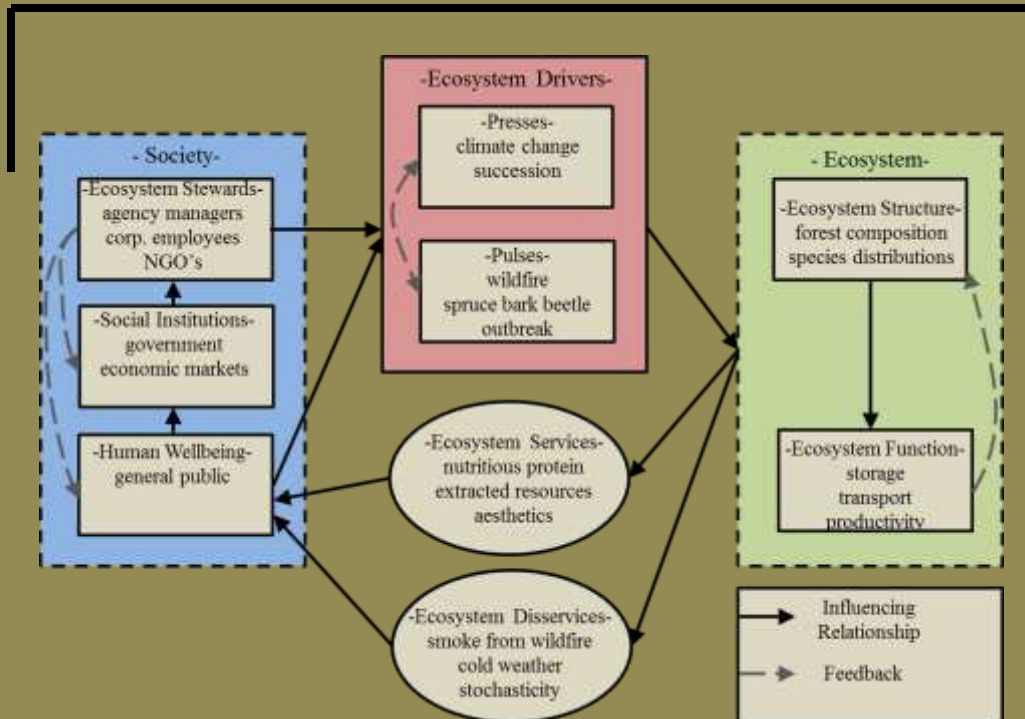


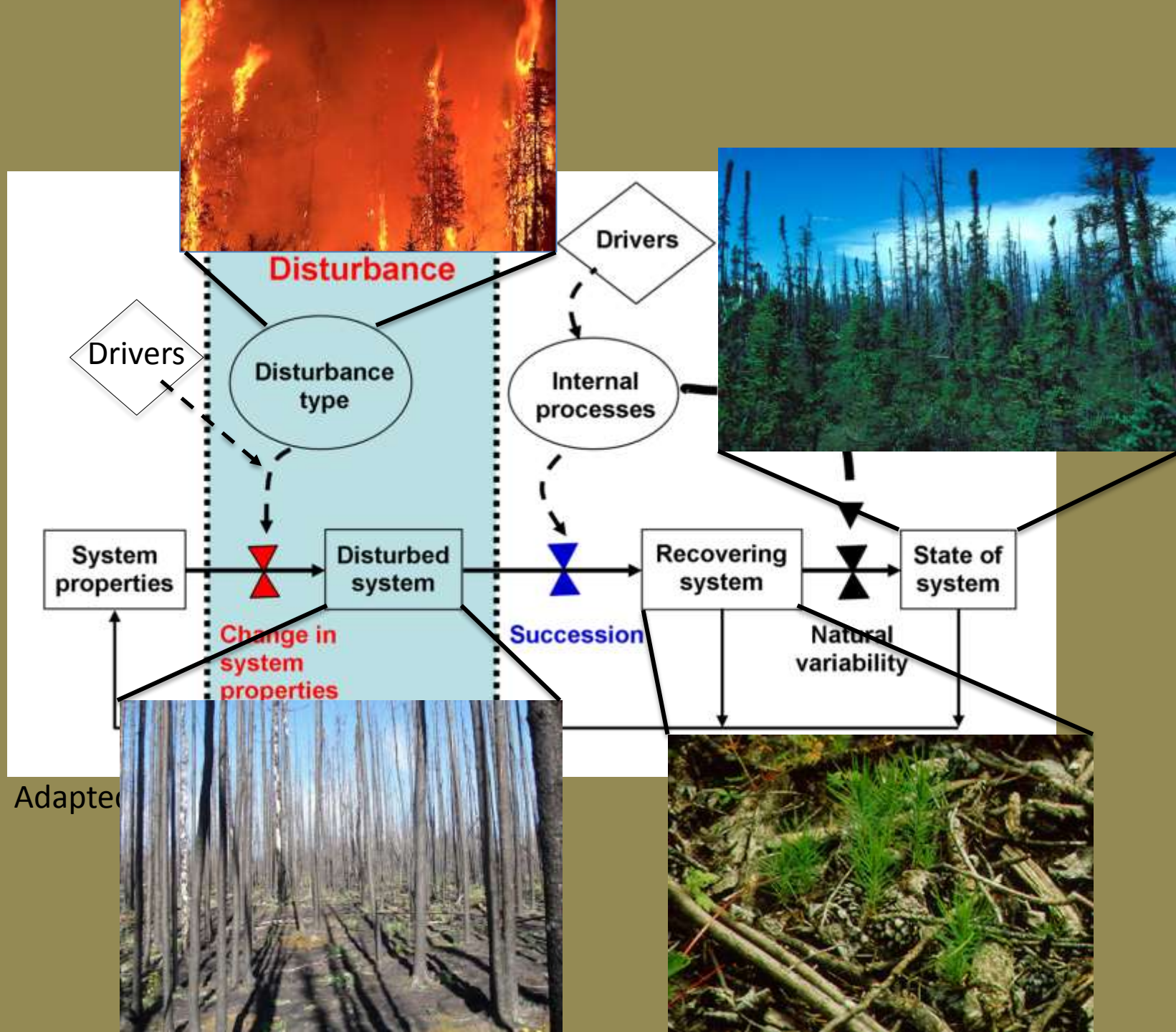
The Press-Pulse SES Framework



Objective 2

Linked Disturbance Interactions in south-central Alaska: The Effects of SBB Outbreak on a Changing Wildfire Regime



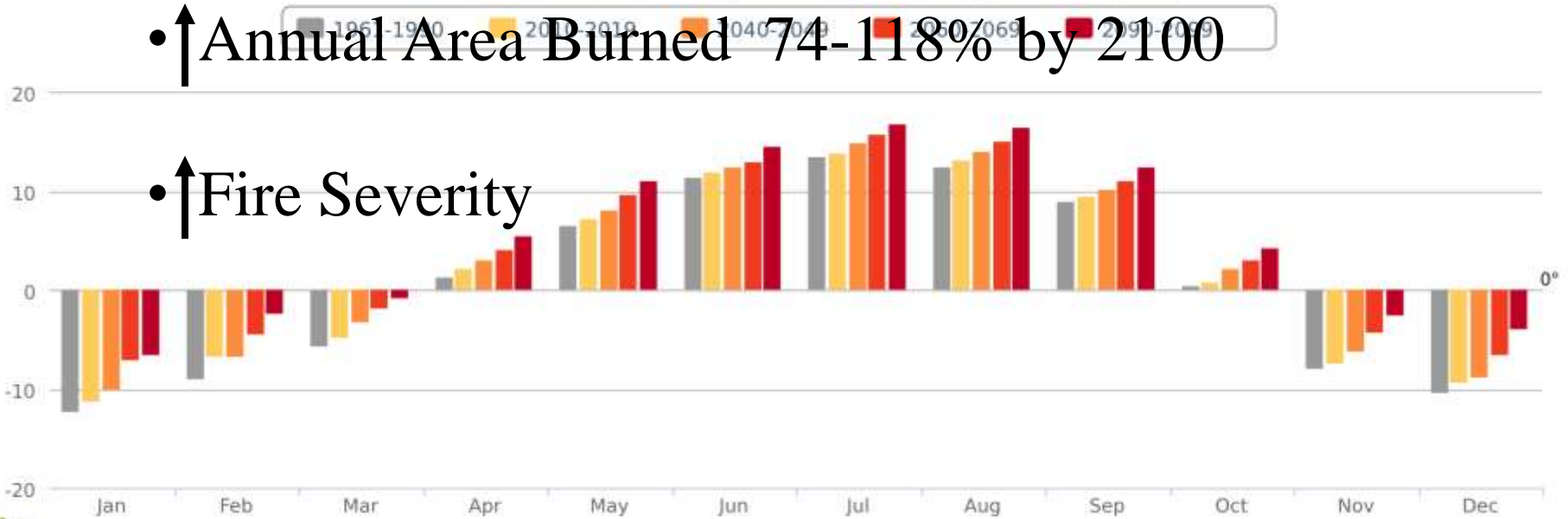


Wildfire Statistics

- ↑ Annual Area Burned 74-118% by 2100

- ↑ Fire Severity

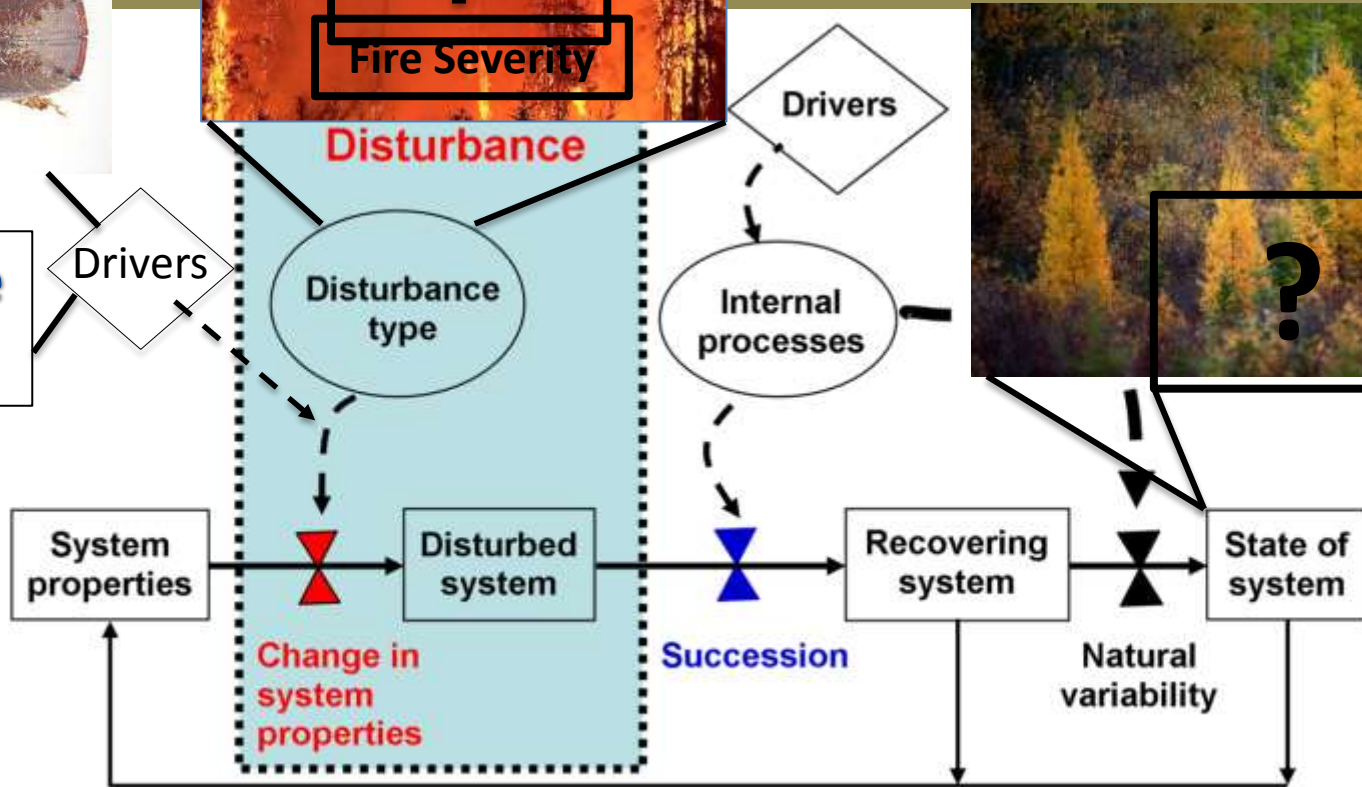
Average Monthly Temperature for Soldotna, Alaska
Historical PRISM and 5-Model Projected Average, Mid-Range Emissions (A1B)



Due to variability among climate models and among years in a natural climate system, these graphs are useful for examining trends over time, rather than for precisely predicting monthly or yearly values. For more information on derivation, reliability, and variability among these projections, please visit www.snap.uaf.edu.

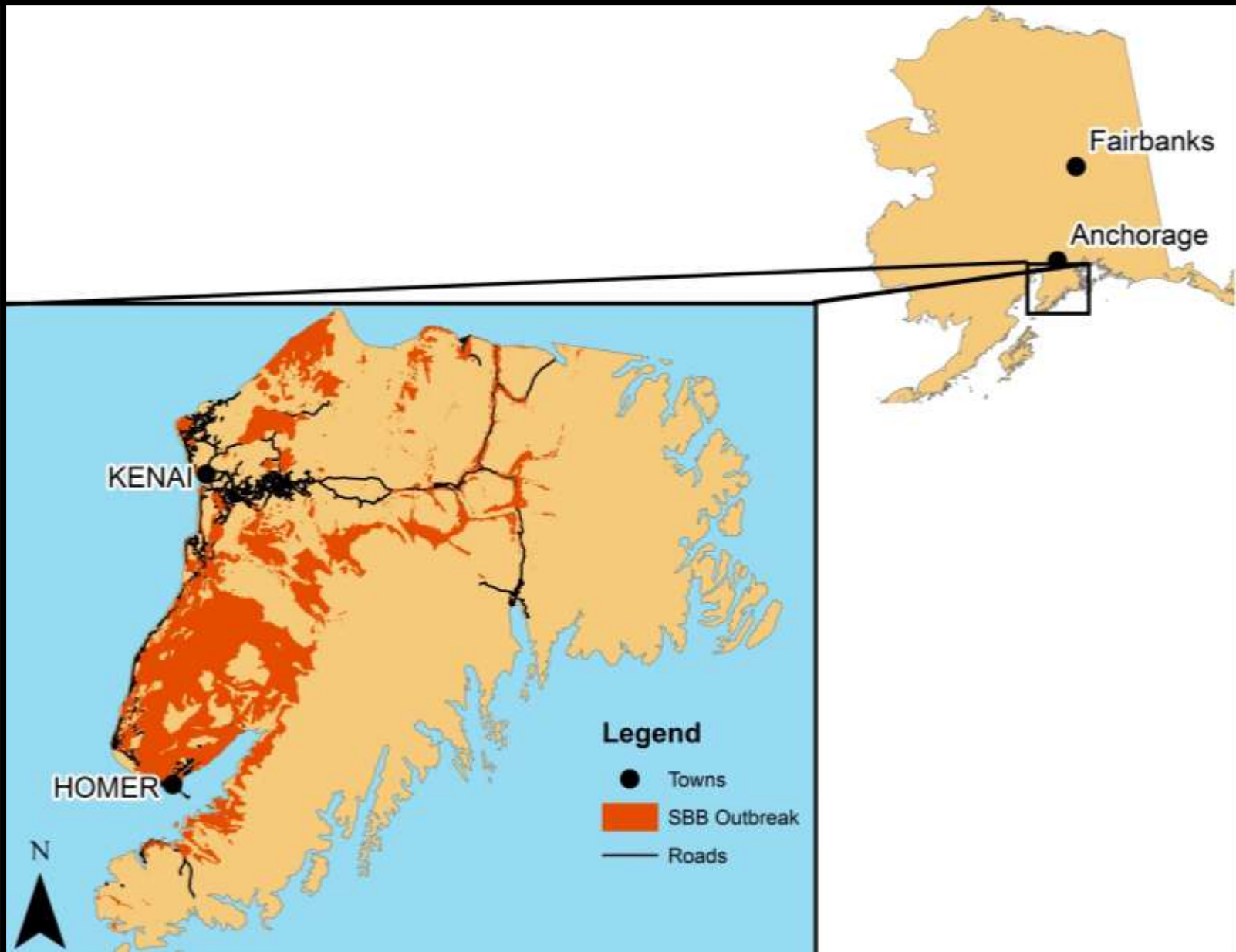


landscape
Drying



Adapted from Peters et al. 2011

Kenai Peninsula



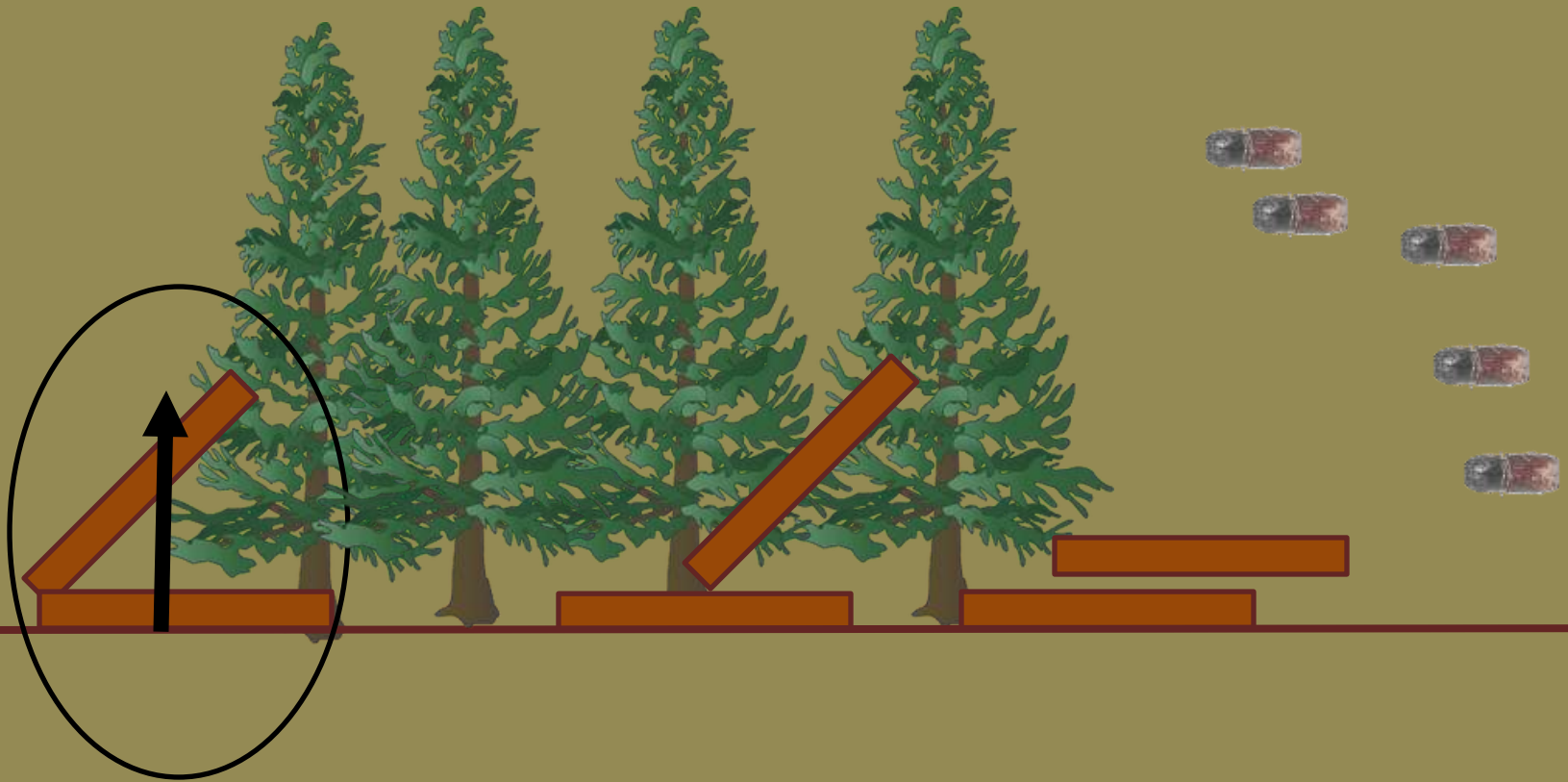
Questions

1. Has the occurrence and length of the 1990's SBB outbreak altered the probability of subsequent wildfire?
2. Does wildfire size change how SBB outbreak affects probability of wildfire occurrence?

Past LDI Findings

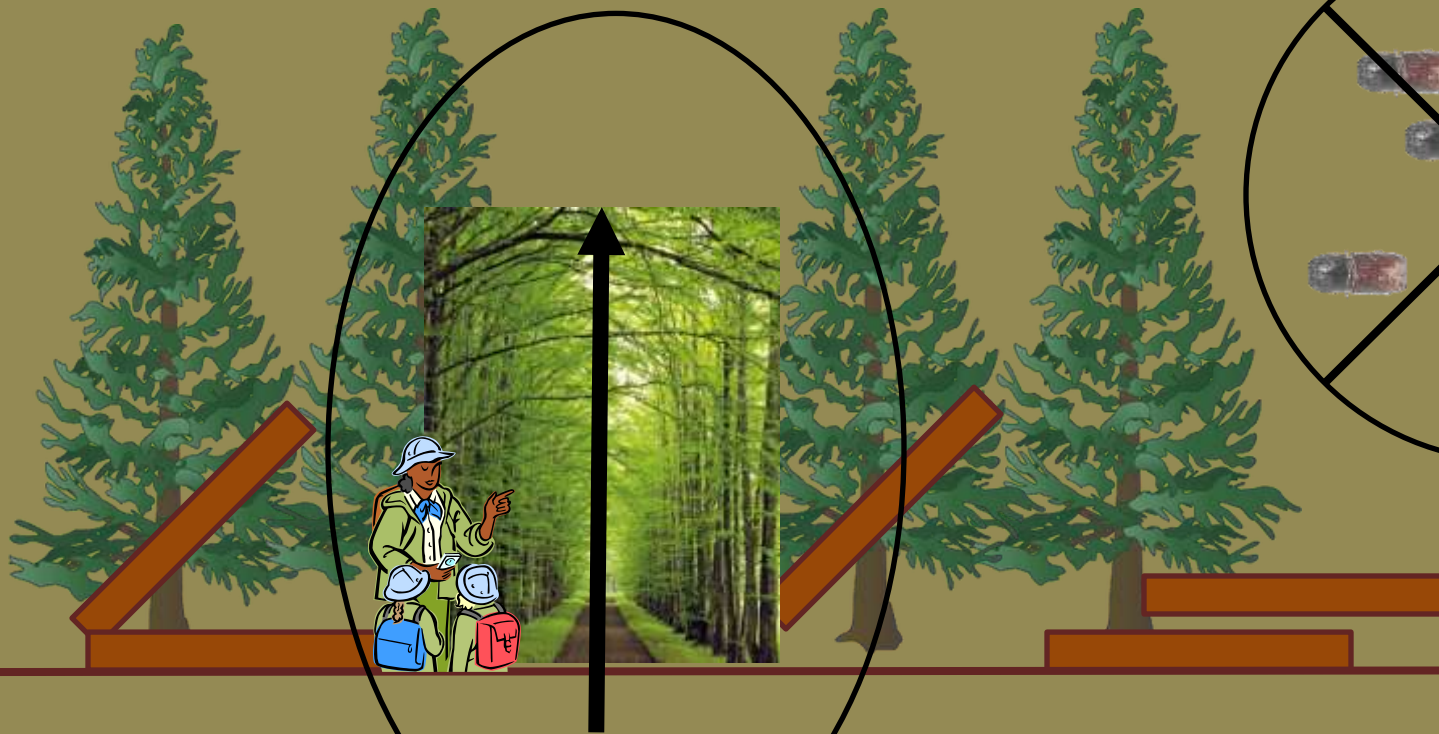
- Kenai Peninsula: SBB outbreaks every 50 years no influence on wildfire.
 - 1990's outbreak more severe + warming temperature trends.
- Rocky Mountains: Little evidence of LDI.
 - Colorado: No effects up to 50 years post outbreak.
 - GYE: Reduction in canopy fire, no increase in surface fuel up to 40 years post outbreak.

Large Wildfire Hypotheses



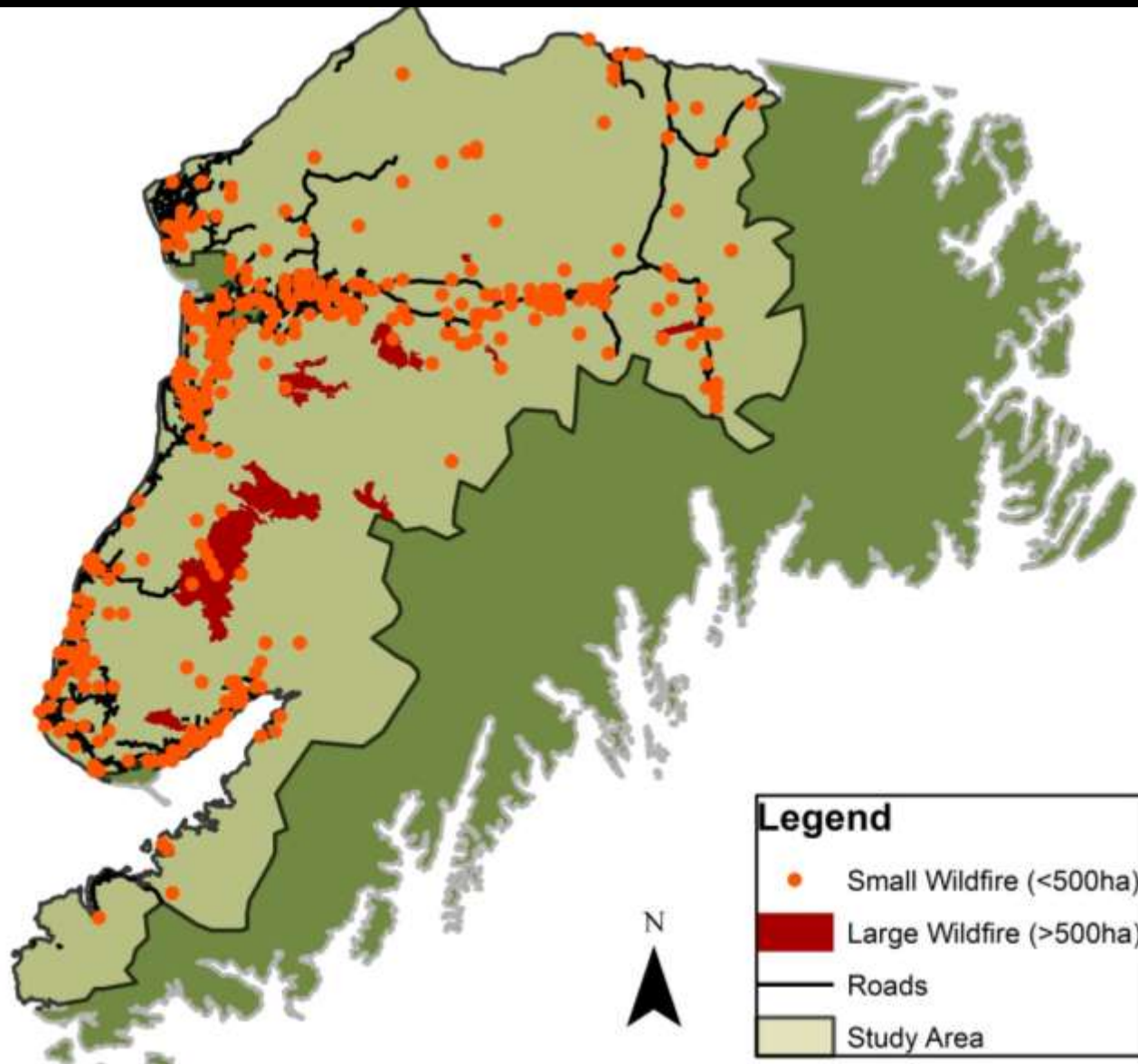
***H1b.* ↑ Large wildfires in SBBs due to SBB breakdowns.**

Small Wildfire Hypotheses



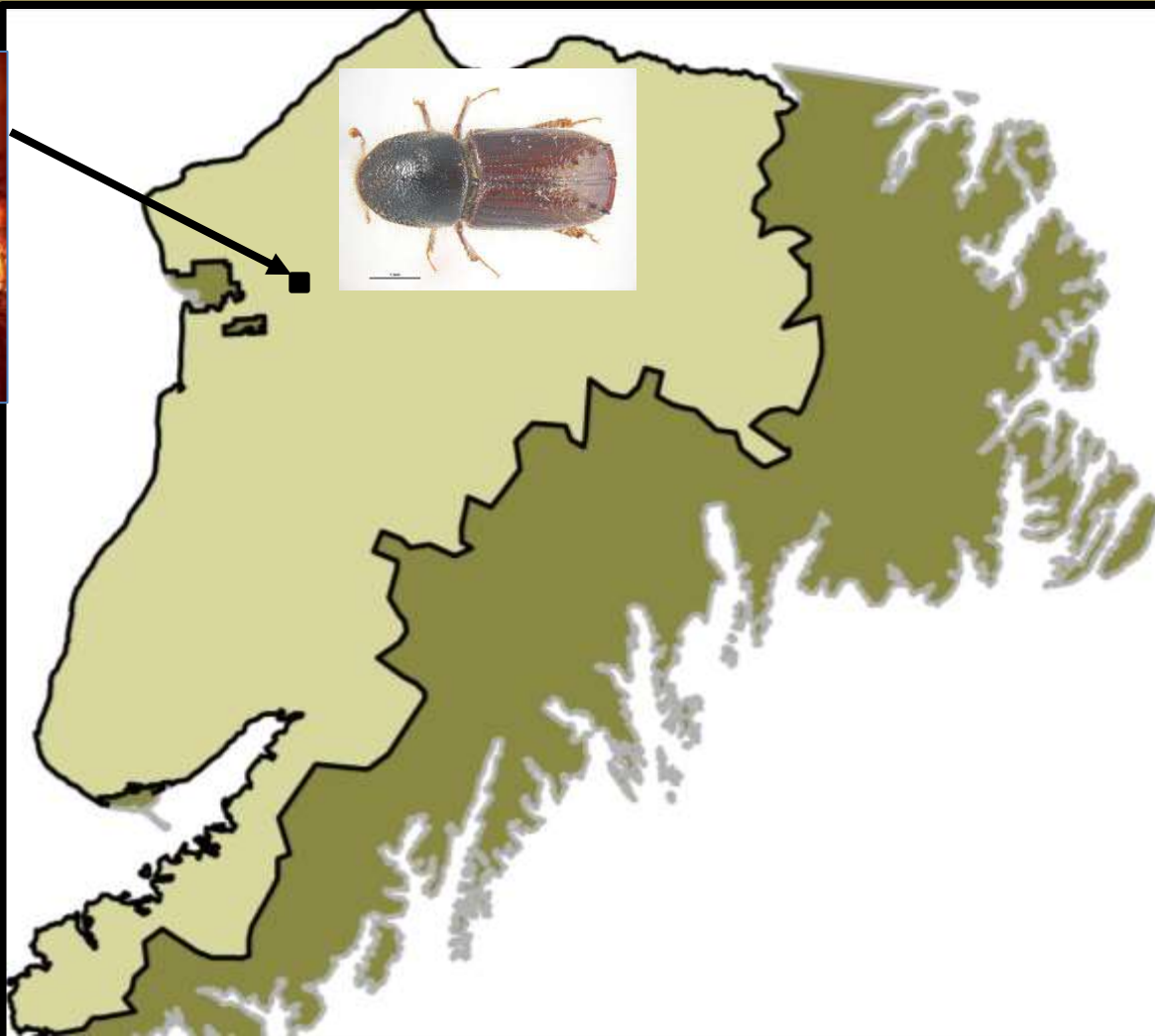
= ~~H2b~~. ↑ Small wildfires close roads designated for active suppression.

Wildfire



Analysis Methods

$P(\text{Fire}) =$ SBB, Other independent Vars.



**Binary Logistic
Regression**

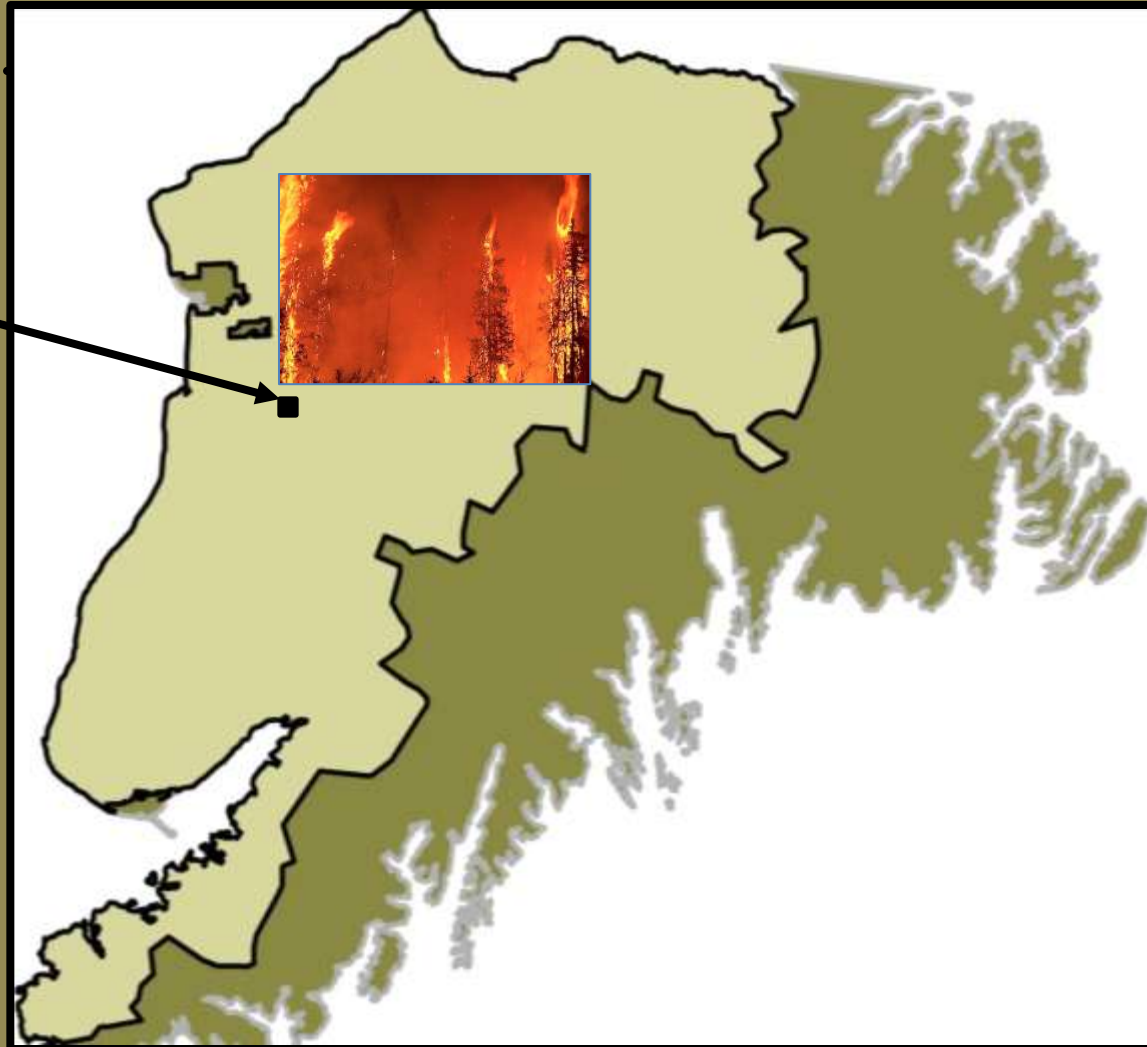
**Rare Events Logistic
Regression w
Replication**

Large Wildfire Results

H1. ↑ Large wildfires
H1a. ↑ Large wildfires
in longer SBB outbreaks.

P(Large Fire)

4.5 times
more likely



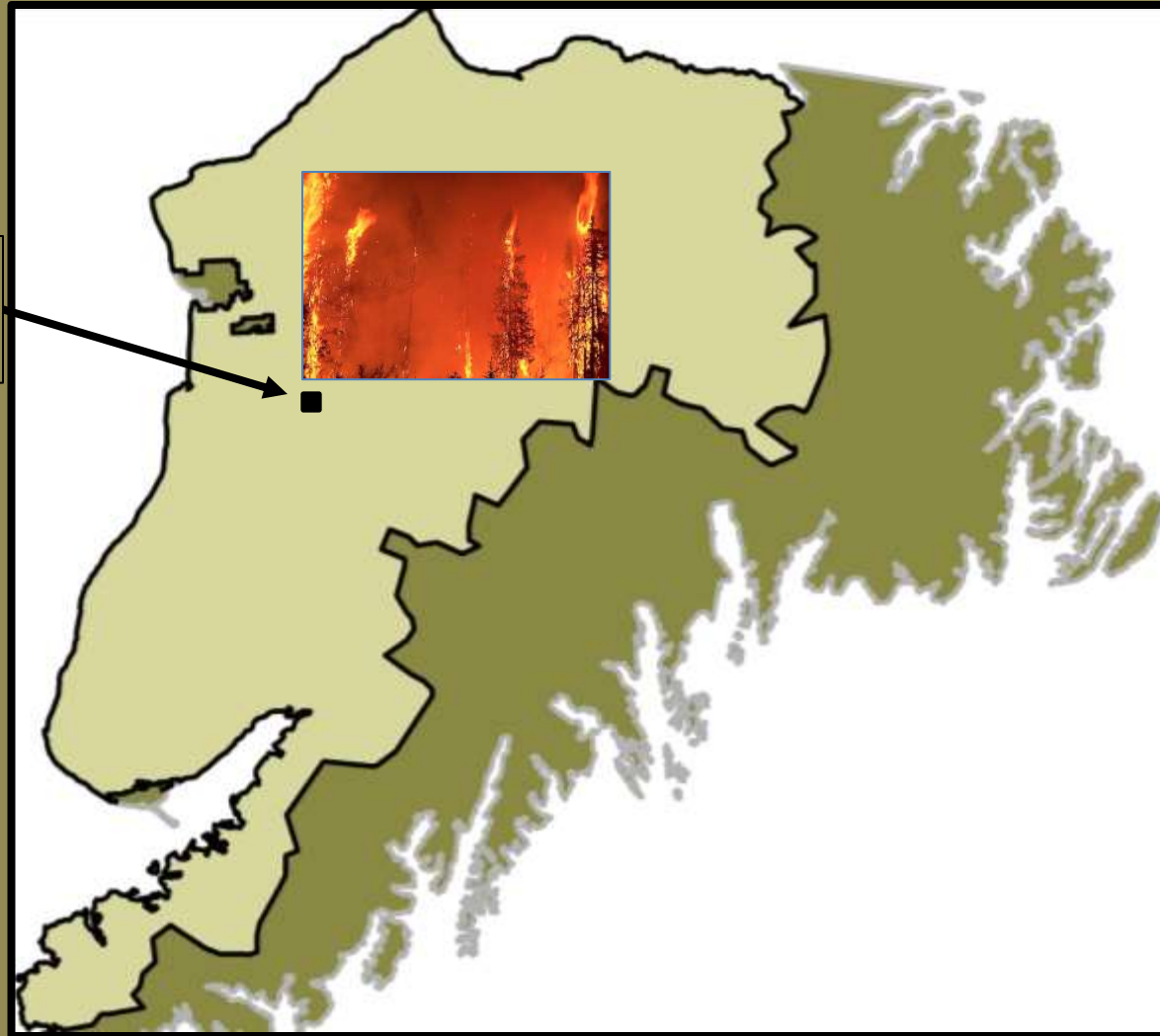
Large Wildfire Results

$P(\text{Large Fire})$

1.9 times
more likely

Active

Suppression

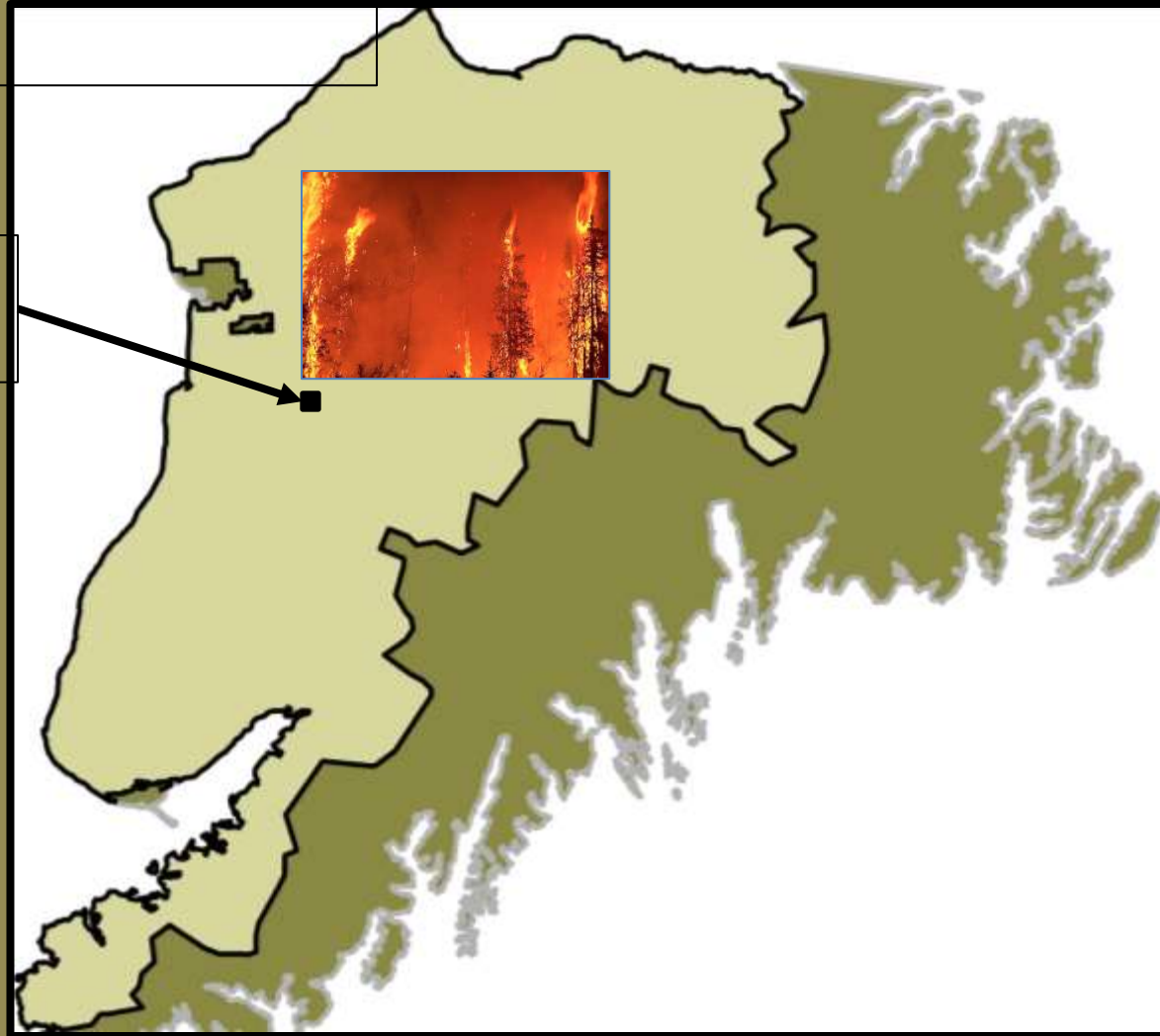
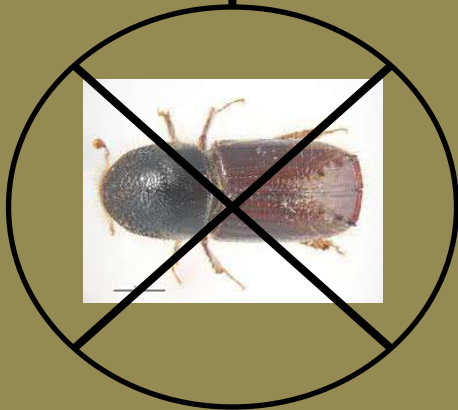


Small Wildfire Results

- **H2a.** Small wildfires close to road network

P(Small Fire)

1.4 times more
likely,
When important



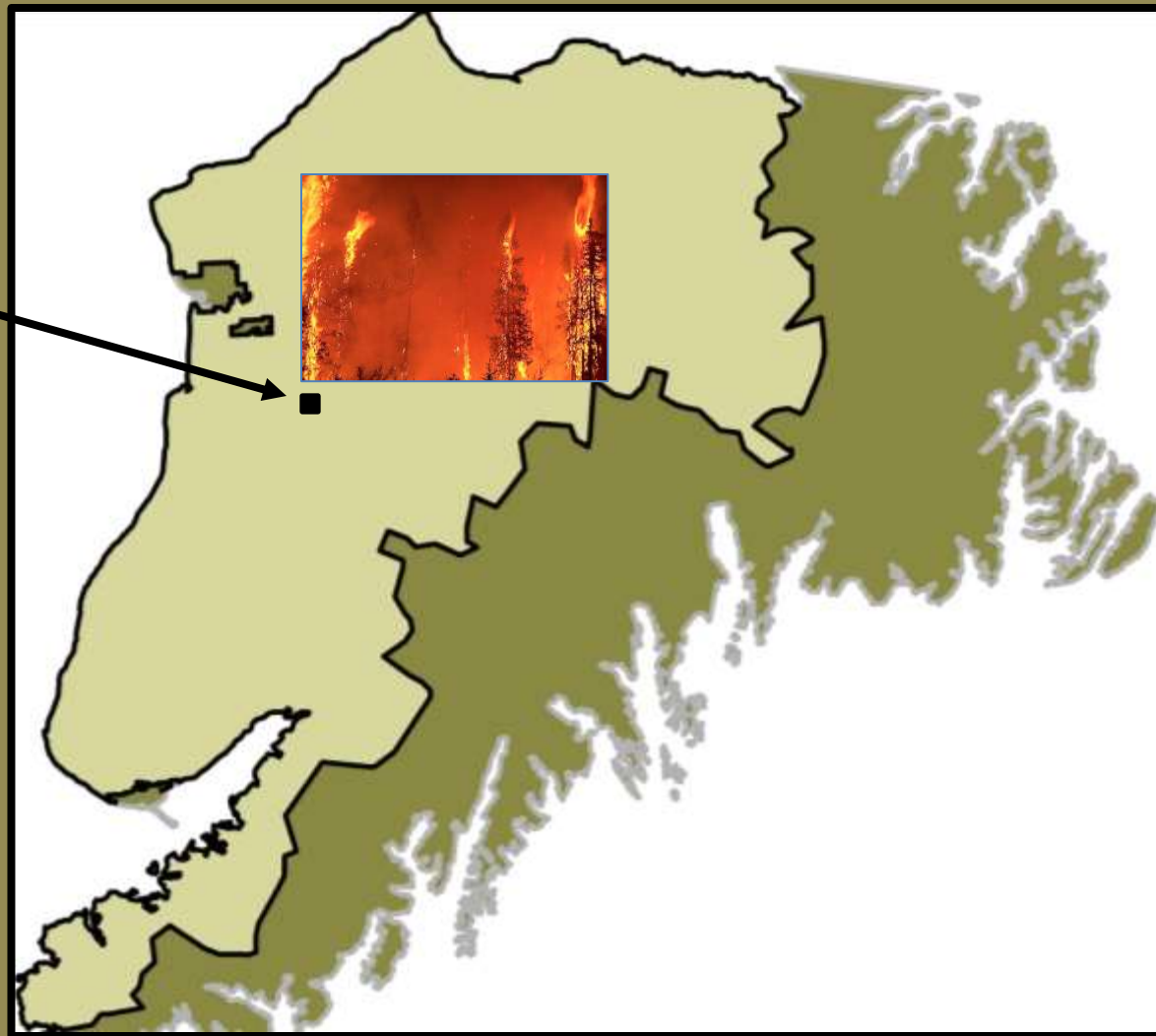
Small Wildfire Results

H2a. ↑ Small wildfires
close to road network.

P(Small Fire)

1.4 times
more likely

↓ **Road
Distance**



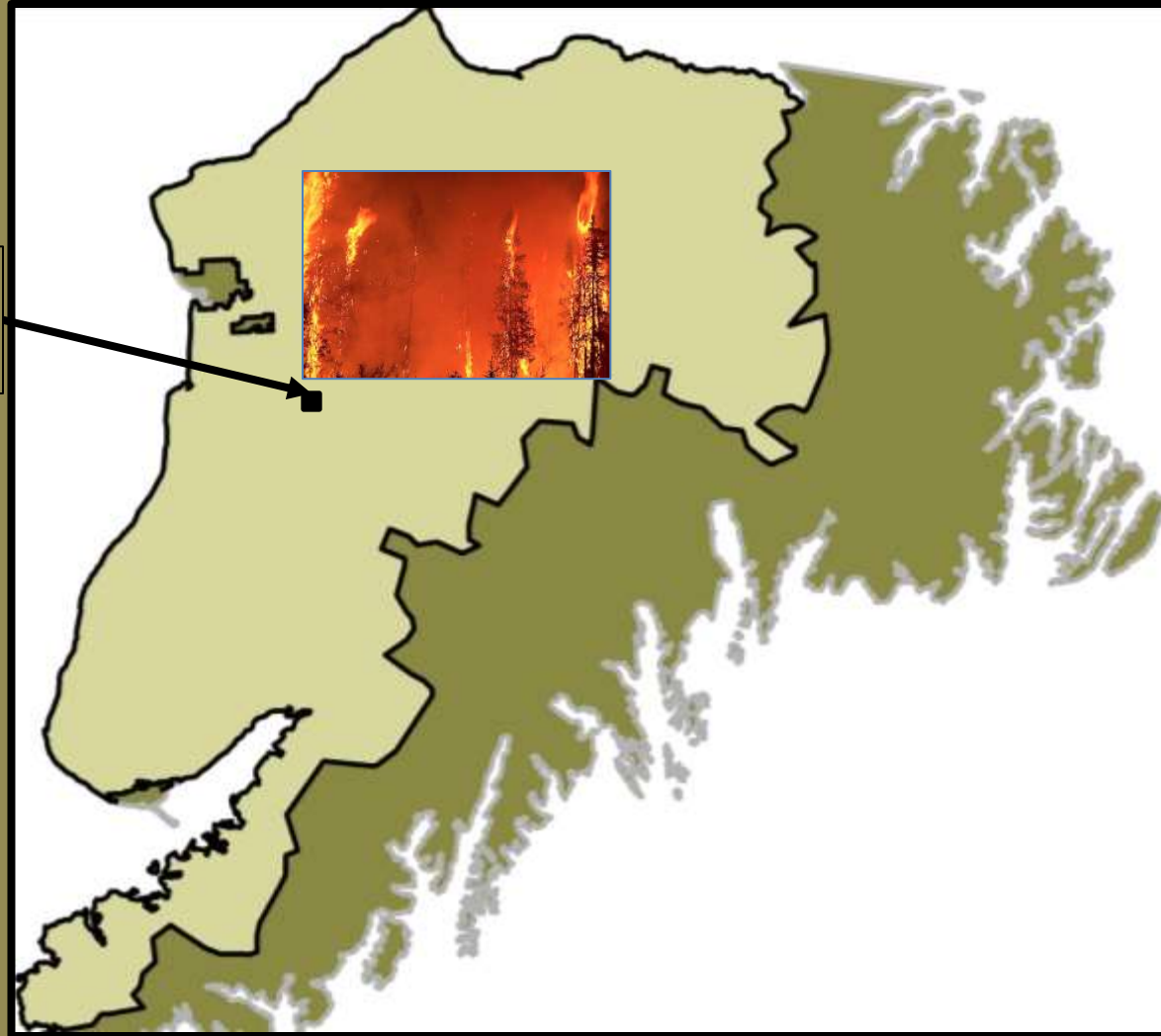
Small Wildfire Results

H2b. ↑ Small wildfires on lands designated for active suppression.

P(Small Fire)

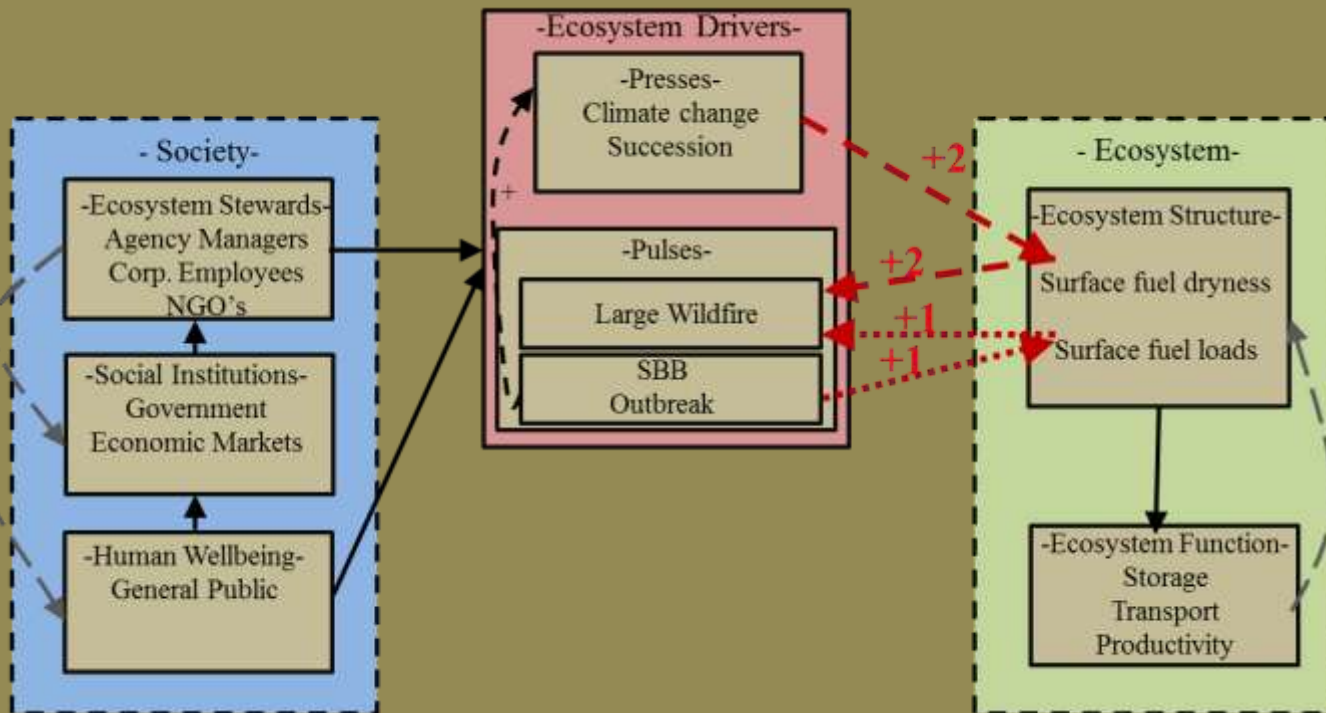
1.5 times more likely, when significant

Active Fire Suppression



Discussion

- Large wildfire occurrence in SBB outbreak:
Why?
 1. Increasing surface fuel loads.
 2. Further amplifying warming climate trends.



Discussion

- ↓ Small wildfire occurrence in SBB outbreak (kind of):
Why?

Perceptions of the SBB outbreak.



Discussion

- ↑ Wildfire occurrence with active wildfire suppression (kind of): **Why?**
 - Active suppression regardless of classification.
- Implications:
 - More late-succession stands.
 - More insuppressible wildfires?



Conclusion and Future Research

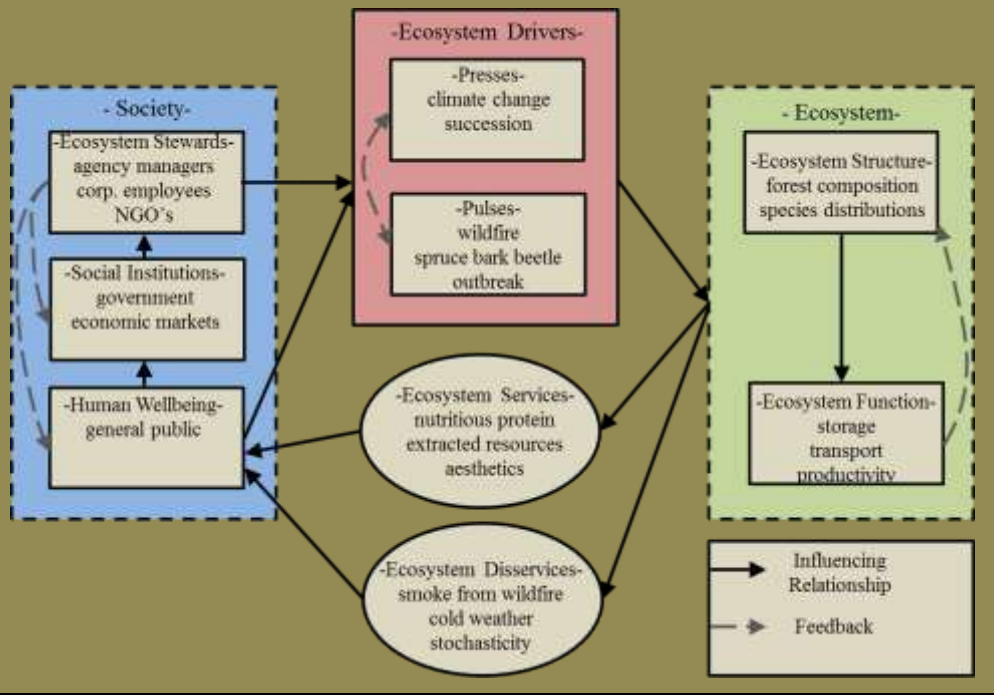
- LDIs: dynamic, system dependent, change over time.
 - Dependent on disturbance occurrence **and** disturbance characteristics.
- **Research Needs:**
 - Identify common drivers.
 - Characterize relationship between drivers and LDIs.

Conclusion and Future Research

- Surface fuel loads.
- Consequences of boreal wildfire suppression.
- **Research Needs:**
 - Fuel load dynamics; applicable boreal wide?
 - SBB-wildfire interactions boreal wide?

Objective 3

The Effects of a SBB outbreak and Wildfires on Property Values in the WUI, South-central Alaska



Management and Perceptions of Natural Disturbance



Managing Human-Disturbance Interactions



Homeowner Perceptions of Natural Disturbance



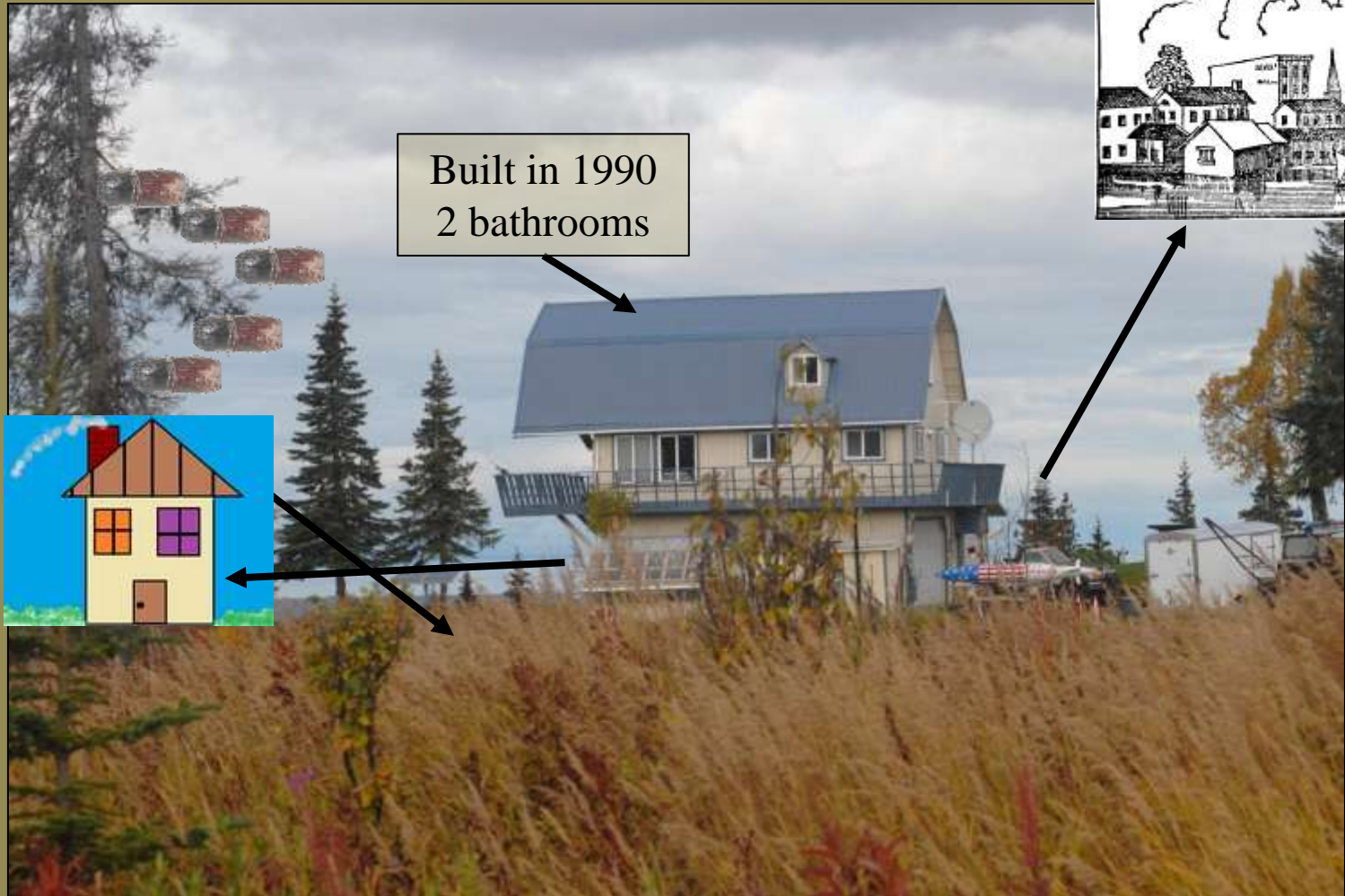
Questions

- 1. How do wildfires and the SBB outbreak influence WUI p
AK? insula,
- 2. How proper and
- 3. Doe ?
- 4. Does the value of one property spillover to affect neighboring properties?



Hedonic Approach

Home Value $= f(E, G, D, S)$



Past Wildfire Studies

- Wildfire ↓ property values.
 - Buffalo Creek Fire CO: Decreased property values 15%.
 - Southern CA: 1st fire reduced property values 10%
2nd fire, 23%.



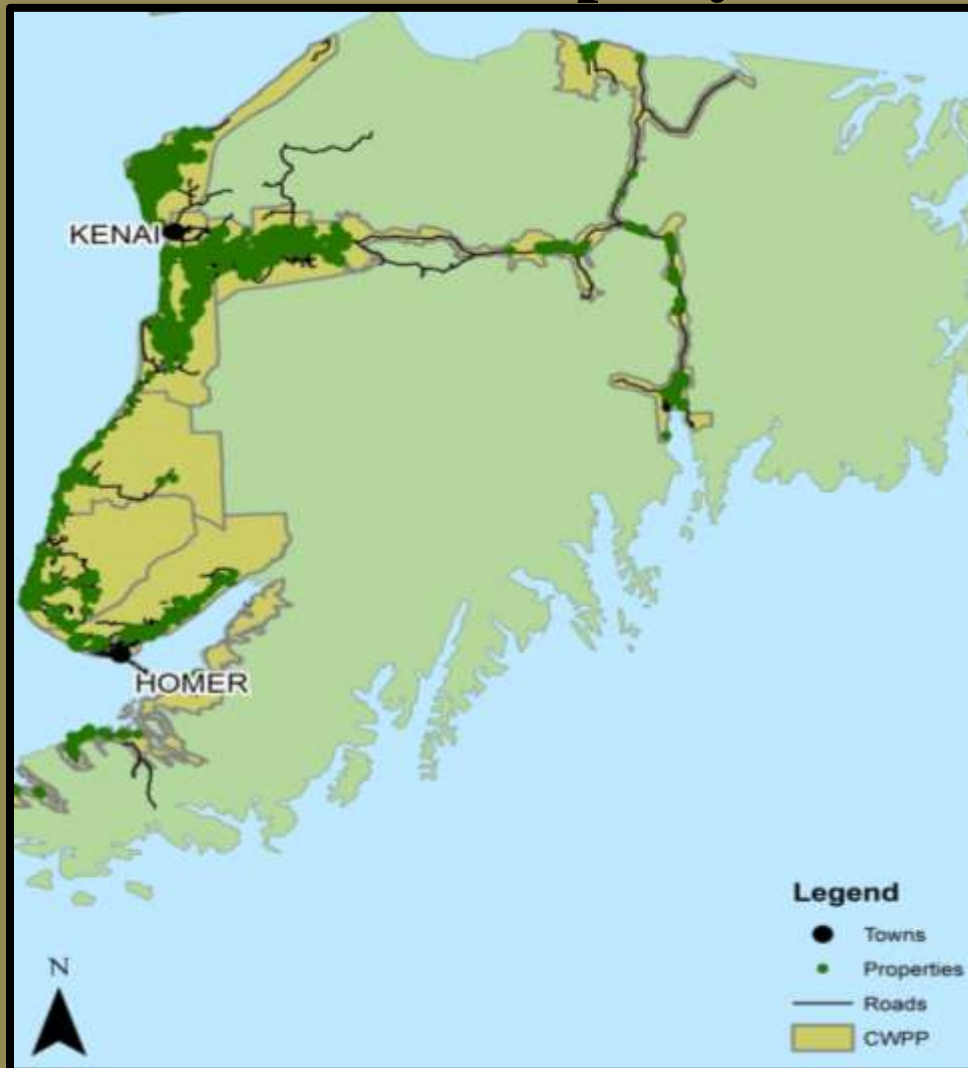
Past Insect Outbreak Studies

- Insect outbreak ↓ property values.
 - Hemlock woolly adelgid: Mixed effects.
 - Mountain Pine Beetle: reduced property values by up to 650 dollars.



Dependent Variable

$\text{Ln}(\text{Assessed Property Value})$



Variables of Interest

- *Natural Disturbance:*
 - Wildfire >3ha, wildfire <3ha, SBB outbreak
 - Three distance bands: 0.1km, 0.5km, 1.0km
 - Time intervals: <5yrs, >5yrs

Controlling Variables

- ***Environmental:***

Seasonal temperature and precipitation, percent forested and non-forested, elevation

- ***Geographic:***

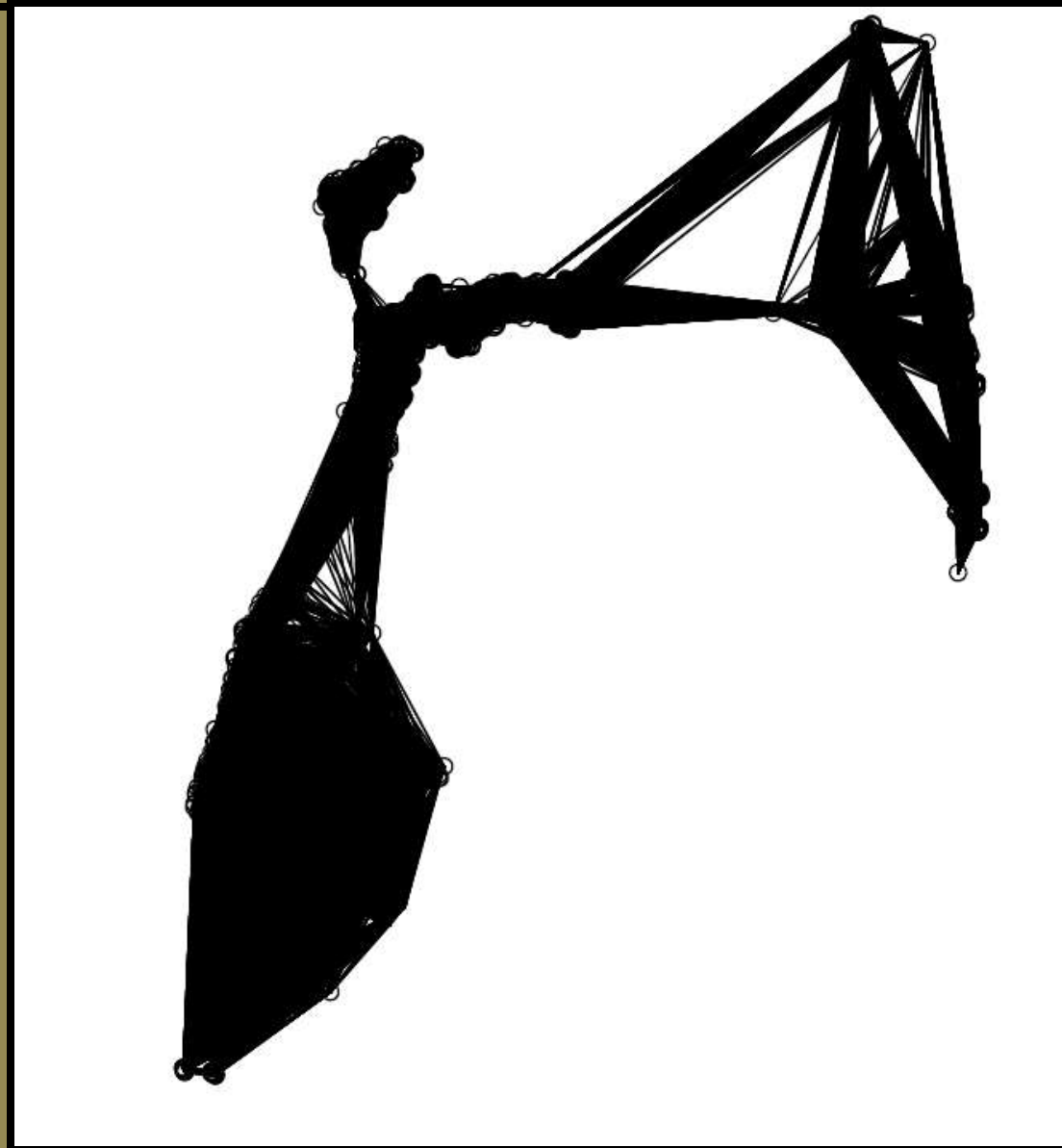
Nearest city, distance to nearest school, nearest roads, coast, nearest water body

- ***Dwelling:***

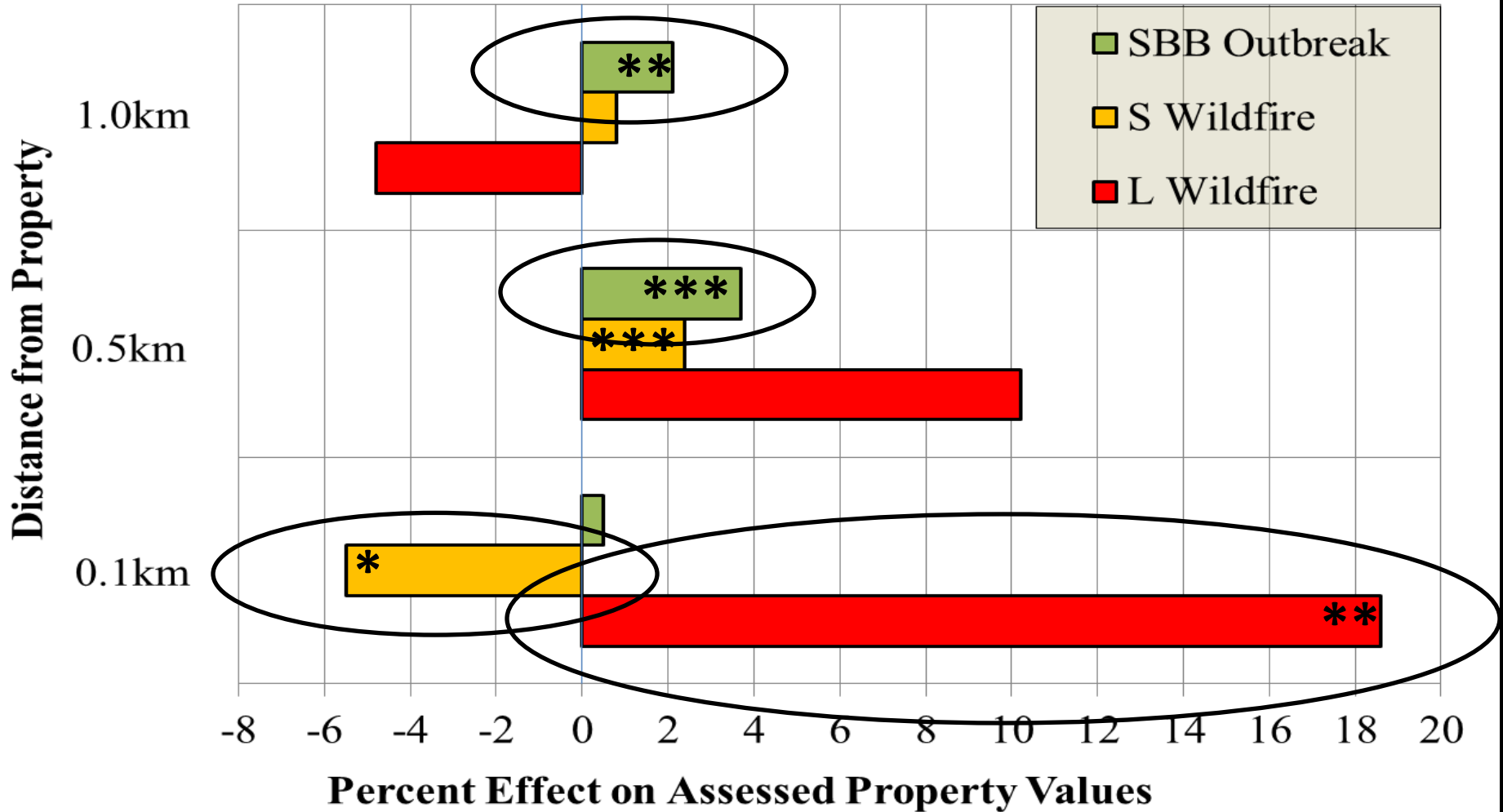
Property size, home age, finished square footage, bedrooms, bathrooms, stories

Analysis

- **1st Law of Geography:**
“Everything is related to everything else, but near things are more related than distant things.”-W. Tobler
- **Spatial mixed-**
Spatial lag and spatial error.



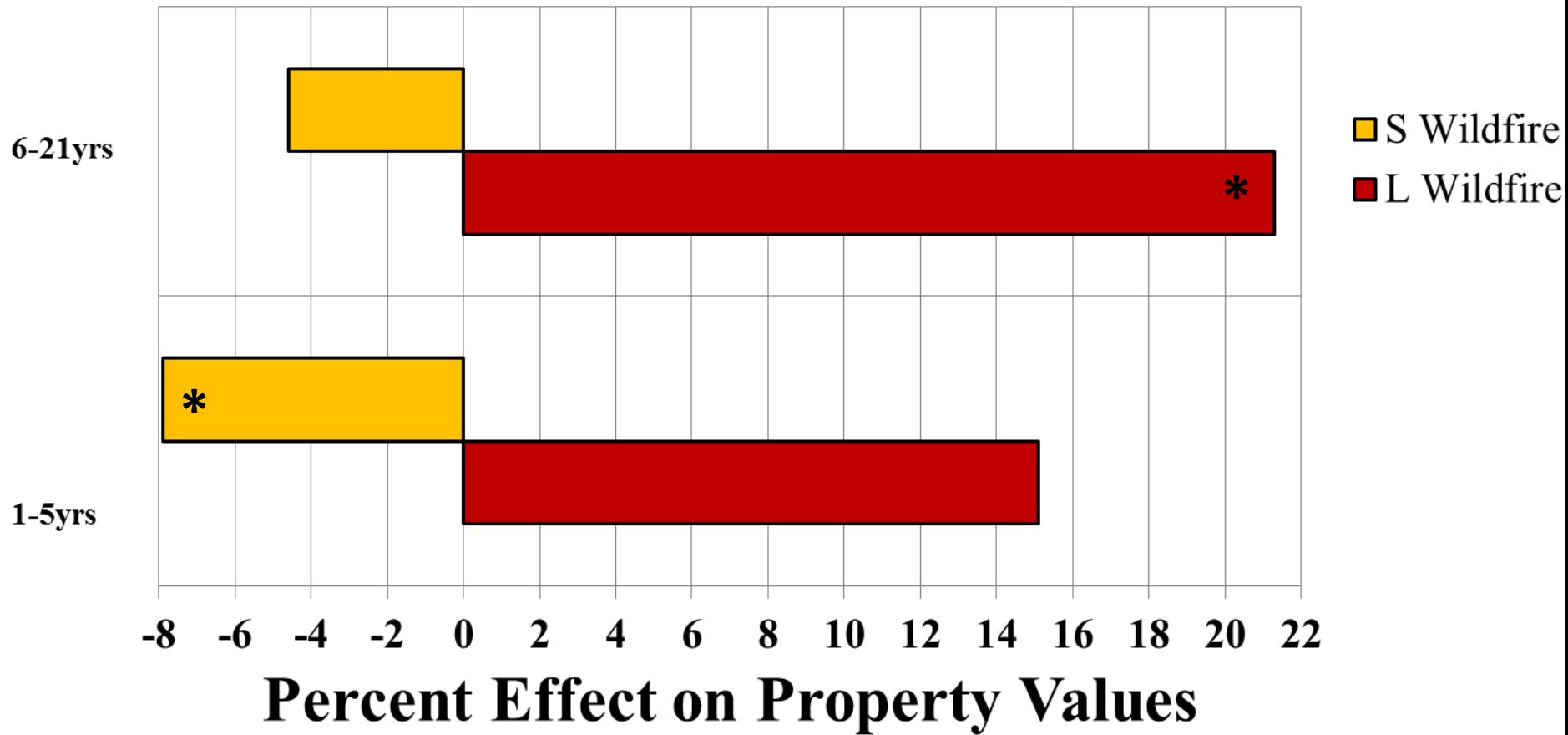
Results



*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Results in Time

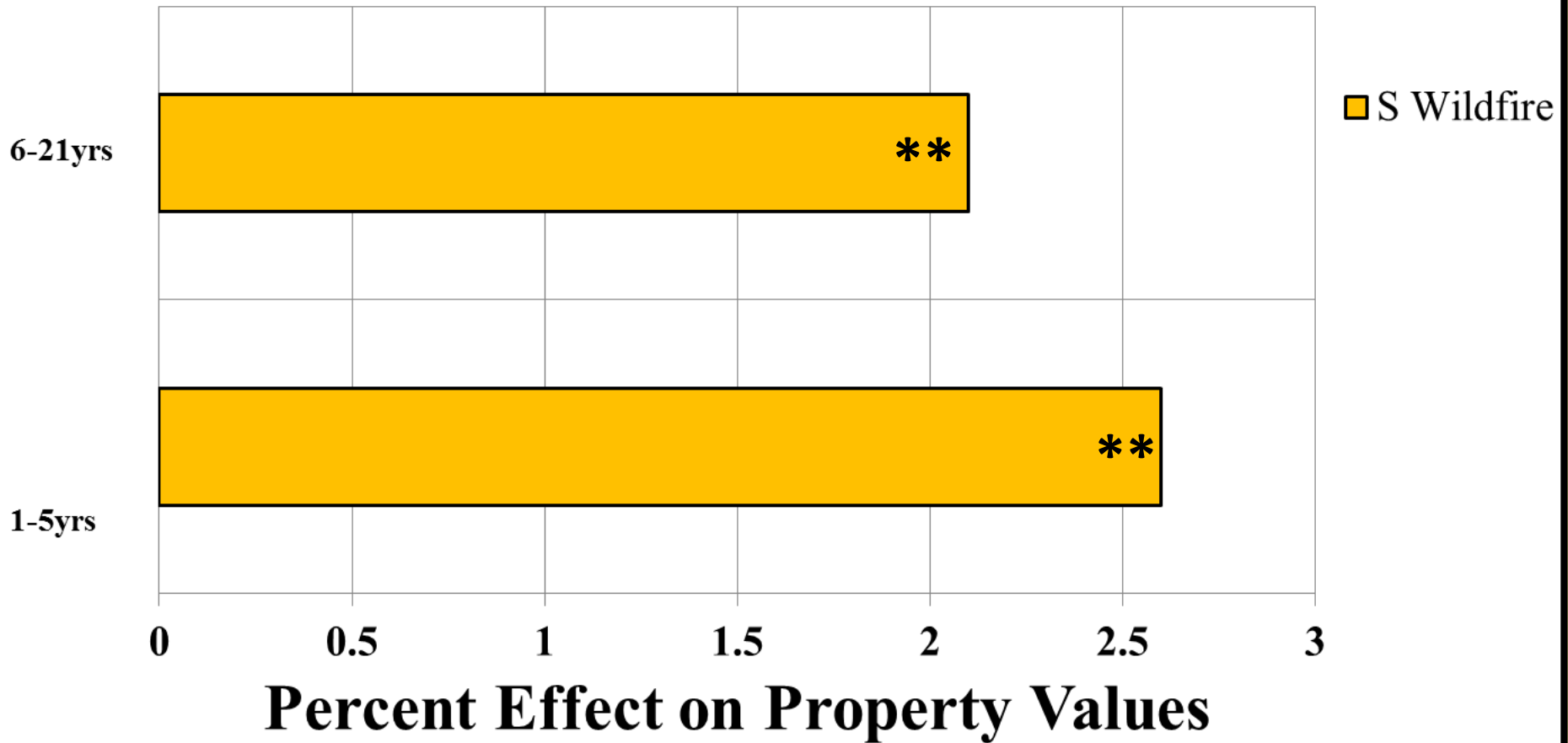
<0.1km Property Center



*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Results in Time

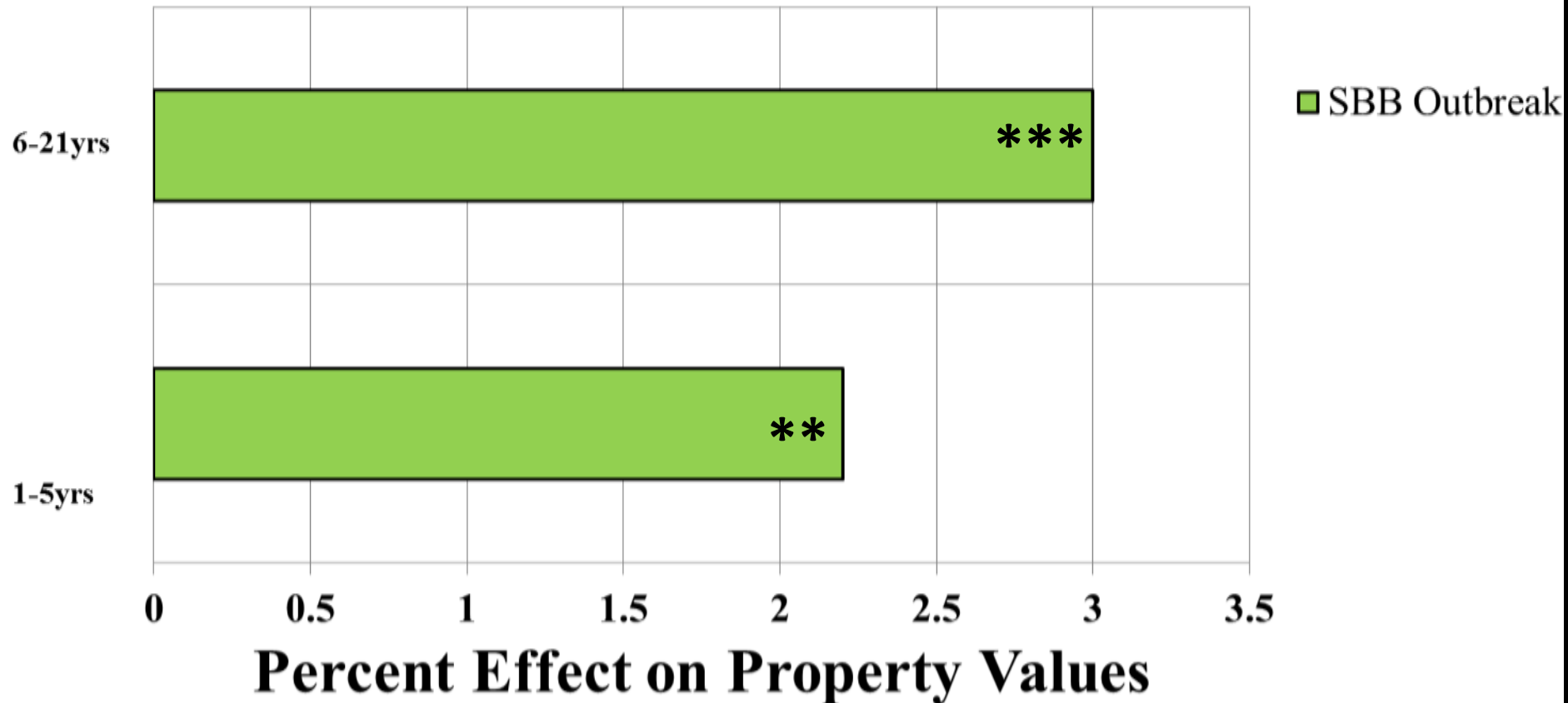
0.1-0.5km Property Center



*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Results in Time

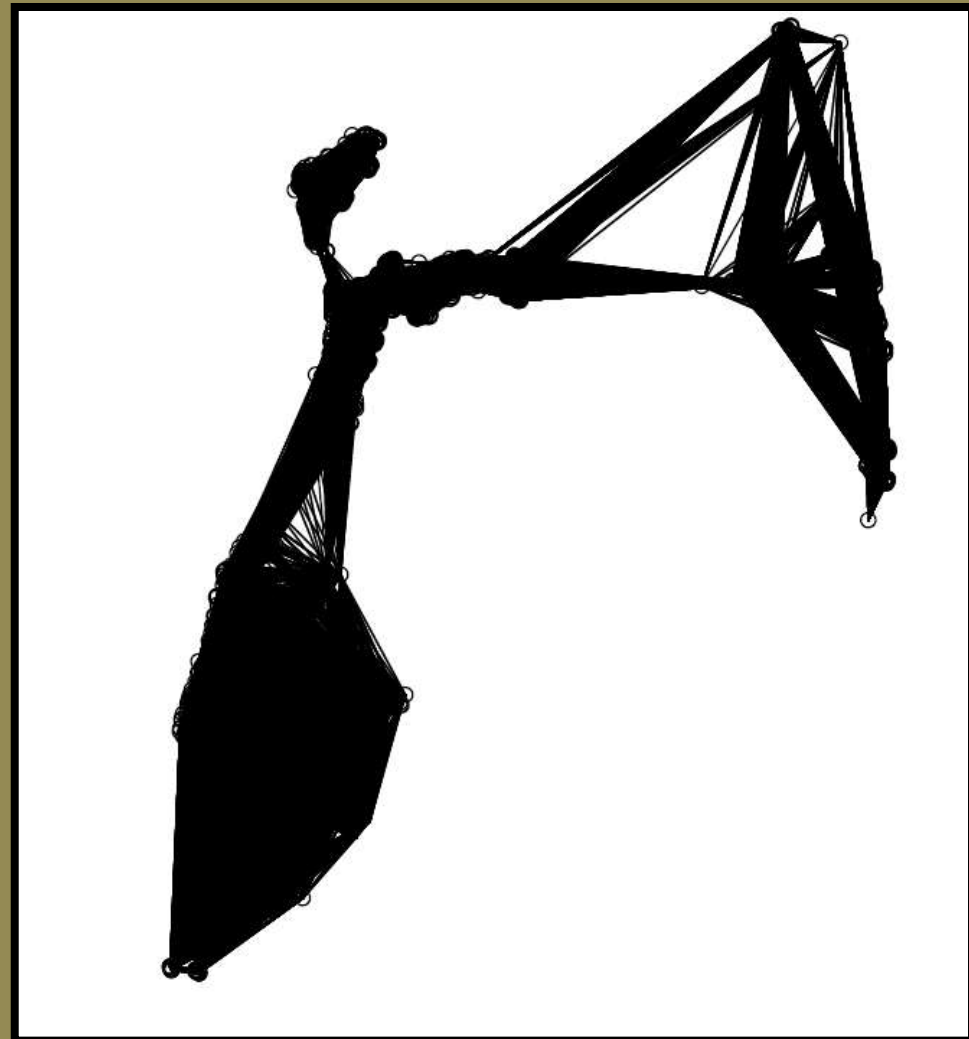
0.1-1.0km Property Center



*** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Results in Space

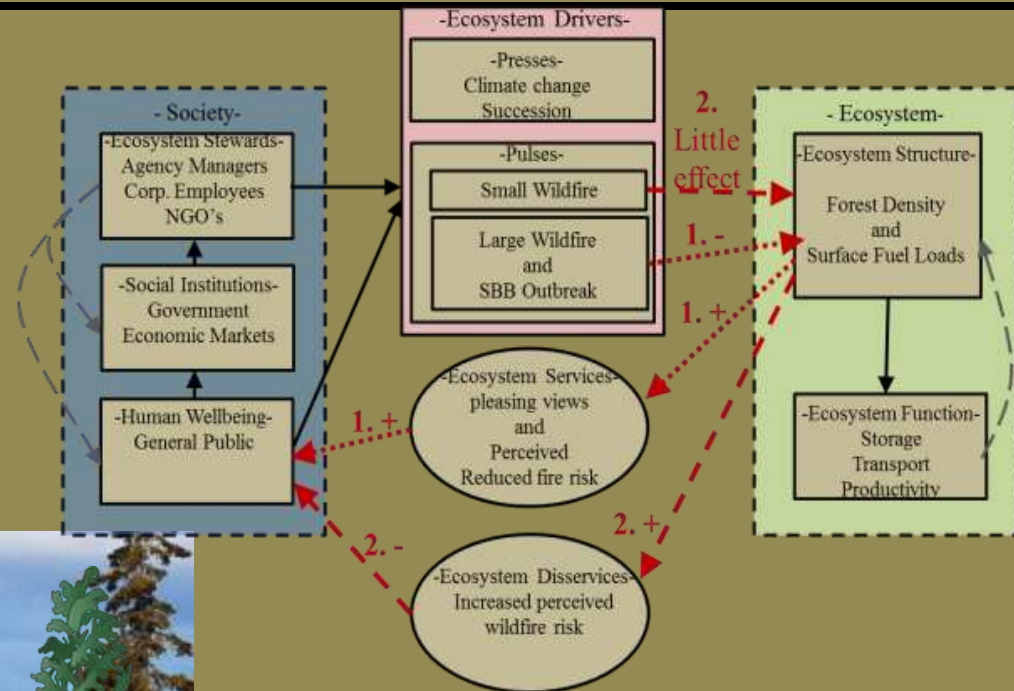
- Spatial Interactions (ρ): 0.9% increase.



Discussion

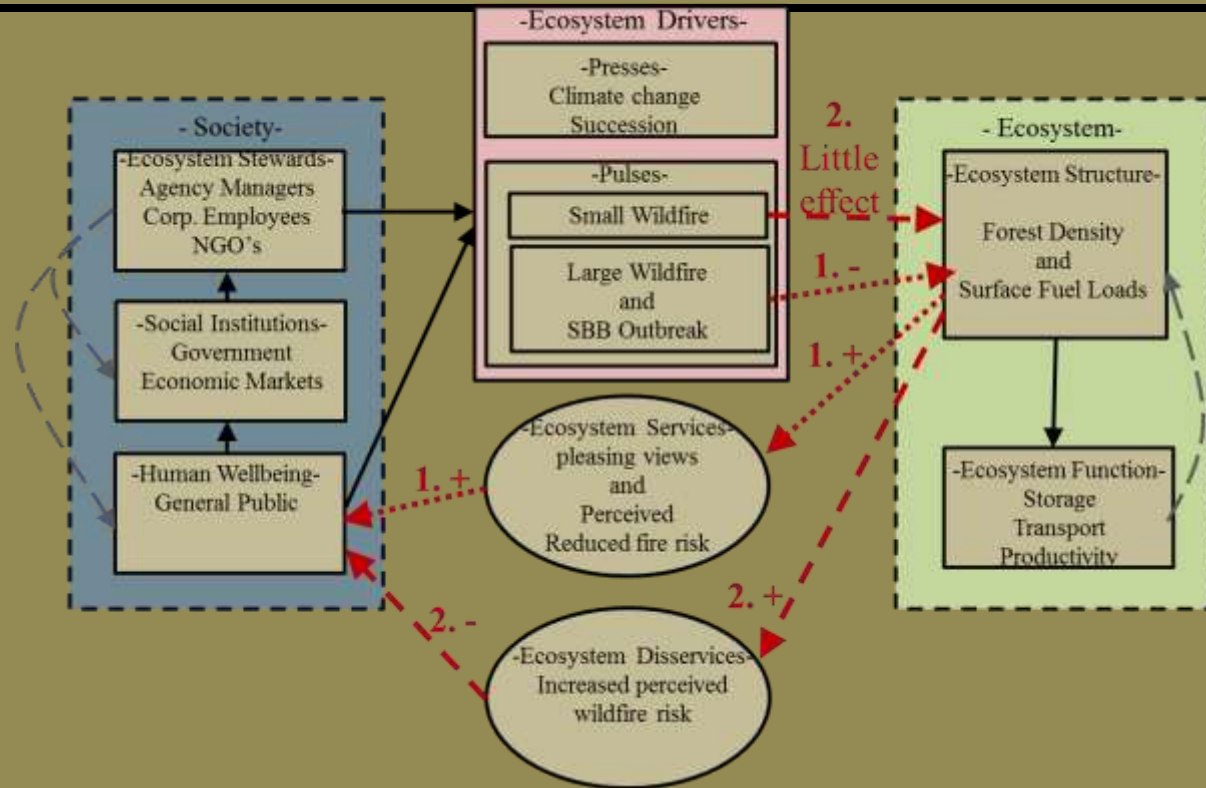
- Value in looking at co-occurring natural disturbances.
- Vary with distance and time.
- SBB outbreak and large wildfires *increased* property values????
 - Very close small fires decreased property values.

Discussion



Discussion

- ↓ Risk of future wildfire.



Discussion

- Past revealed preference studies, Mixed findings:
 - Provide support for emerging views hypothesis
 - 67% respondents cited ↓ property values as negative impact.
- Complex and dynamic view points!

Future Research Needs

- Mechanisms through which people perceive natural disturbance?
- Challenging perceptions vary over:
 - Space, time, and between people in single location.
- Revealed preference vs. stated preference.

Management Implications

- **Strategically design fuel reduction treatments.**
 - Enhance views as homeowner incentive.
- **Take advantage of spatial spillovers.**
 - ↑ Property values ↑ neighboring property values.
 - Motivate broad community participation?
 - Increase pressure on those resistant to action?



FIREWISE
KENAI PENINSULA

Final Conclusion: Ecosystem Stewardship in a Changing Boreal SES



Axiom 1:

As an ecosystem steward, spend half your time thinking about ecology and half on people.



Axiom 2:

SESs are dynamic and stochastic:
Experiment.



Axiom 3:

Use the best available science: Do not let it handcuff you.



Axiom 4:

The only panacea is time, money, and passion.



Photo Attributions

- <http://homertribune.com/wordpress/wp-content/uploads/WildFireSeason.jpg>
- <http://wiki.resalliance.org/images/f/fb/SES.jpg>
- http://solarsystem.nasa.gov/images/VIIRS_4Jan2012_708x432.jpg
- Ann Olsson
- http://www.lternet.edu/sites/default/files/styles/site_image/public/bnz.jpg
- http://www.whrc.org/ecosystem/highlatitude/images/temp99_09.jpg
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- http://blog.allstate.com/wp-content/uploads/2012/06/Wildfires_cover1-680x260.jpg
- <http://www.organic soul.com/wp-content/uploads/2011/06/Beetle.png>
- <http://seagrant.uaf.edu/nosb/papers/2004/images/ninilchikdeadforest.jpg>
- <http://forestry.alaska.gov/wildland.htm>

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- **Friends and Family!**

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And of course the Cats!!!



Questions?

